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ABSTRACT

Vocational Preference Inventory (VPI) scores and vocational choice were collected from 6,289 male freshmen at 31 colleges in the spring of 1964. The same data was collected from 12,345 male two-year college freshmen at 66 institutions in 1968. From the correlation matrix of the six VPI scale scores given in Holland, a principal components analysis was performed. Through occupational configuration, a two dimensional map was set up showing the relationship of occupations to each other on the basis of VPI. Holland's classification differs from configural analysis because of the latter use of standardized scores. Several concepts can be operationalized through the use of configuration, such as: (1) job similarity, (2) congruence of an individual and occupation, (3) stability of occupational choice and (4) differentiation of interests. Other potential uses of spatial configuration are discussed in relation to research questions. (KJ)

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A SPATIAL CONFIGURATION OF OCCUPATIONS

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In a recent paper, Holland et al (1969) presented a revised empirical classification of occupations using the six scales of Holland's Vocational Preference Inventory (VPI) and based on his theory of the psychology of vocational choice. An important result reported in that paper was the hexagonal configuration model for the six VPI scales. The hexagonal arrangement was confirmed by a statistical analysis which located the six scales in a "best-fitting" plane. This formulation can also be extended to the location of individuals and occuaptional groups on the plane.

The present analysis was performed in an attempt to form a basis for describing the relationship among occupational groups. The need frequently arises in vocational counseling for a method of suggesting potential careers related to a client's expressed interests. Clients who are undecided or at an exploratory stage in their vocational development may be assisted by referring them to groups of related occupations. In addition, in research the concept of relatedness or degree of similarity of occupations often arises. This study offers one method for defining "related" occupations which may have implications for the counseling and research settings.

The statistical approach used in the present study results in a visual and spatial organization of occupations. The resulting spatial representation is presented and some of the implications of the configuration are discussed.

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The Sample

The data for this study were VPI scores and expressed vocational choice

of male college freshmen. The VPI is a list of occupational titles on which students check those that interest them. The occupational titles are grouped into scales of Realistic, Intellectual, Social, Conventional, Enterprising, and Artistic vocational interests which correspond to Holland's (1966b) personality types. A score on each of the six scales was obtained for each student. Expressed vocational choice was obtained by asking the students to select from a list of occupations "the occupation you plan to enter."

VPI scores and vocational choice were collected from 6,289 male freshmen at 31 diverse colleges in the spring of 1964 as described in Abe et al (1965). In addition, the same data were collected from 12,345 male two-year college freshmen at 66 institutions in 1968 as described in Holland et al (1969). Follow-up data giving vocational choice nearly one year later was available on 3,869 males of the 1964 sample.

The Configural Analysis

From the correlation matrix of the six VPI scale scores given in Holland (1968, p. 35), a principal components analysis was performed. Since the first three dimensions accounted for 78% of the trace, as shown in Table 1, only these three factors were used.

Table 1

Principal Components Analysis of VPI Scales

Factors	1	2	3
Roots	2.37	1.17	1.13
Percent Trace	39.6	19.5	18.8
VPI Scales		Loadings	
Realistic	.528	.462	-.541
Intellectual	.442	.785	.021
Social	.685	-.132	.401
Conventional	.710	-.347	-.454
Enterprising	.799	-.421	-.051
Artistic	.537	.153	.680

All six scales had high positive loadings on the first dimension of variability, which may represent overall checking rate on the VPI (one kind of response set). Thus the scales lay very nearly in a plane perpendicular to the first factor. By using the factor loadings to locate the six points in three-space, the smallest characteristic vector of the covariance matrix of the three factor scores over the six points is in the direction which minimizes the squared deviations from a plane fitting the six points. The two largest characteristic vectors correspondingly span this "best-fitting" plane. When the points in three space (the six VPI scales) are projected onto this plane, the result is a two dimensional representation of the six points.

To locate an individual or occupational group mean profile on this plane, the three factor scores are approximated, then the point in three space is projected onto the plane.[1] This procedure is combined into one operation by premultiplying the vector of standardized profile scores by the matrix Q given in Table 2. The VPI scores in this study were

Table 2

Projection Matrix for Placing
a Standardized Profile Vector onto the Plane

	R	I	S	C	E	A
Q =	-1.266	-0.311	0.876	-0.709	0.124	1.289
	0.416	1.292	-0.202	-1.020	-0.970	0.481

[1]By the factor analysis model the set of factor loadings in Table 1, say A (6×3), gives the approximation, $\underline{z} = A\,\underline{f}$, where $\underline{z}$ is a vector of standardized scale scores and $\underline{f}$ is a 3×1 vector of factor scores. Since $A'A = \Delta$, a diagonal 3×3 matrix of the first three characteristic roots, $\underline{f} = \Delta^{-1}A'\underline{z}$. If B is the 3×2 matrix of factor loadings from the covariance matrix of the original three factor scores, then $(B'B)^{-1}B'$ is the 2×3 projection matrix which projects a point in the three space onto the plane. Thus the six component standardized vector $\underline{z}$ is projected onto the plane by premultiplying it by a 2×6 matrix $(B'B)^{-1}B'\Delta^{-1}A = Q$.

standardized using the means and standard deviations reported in Holland (1965, p. 32) and given below.[2]

The Occupational Configuration

Students with the same vocational choice were grouped together and the standardized VPI scale means for each group were projected onto the plane as described in the preceding section. The result gives a two dimensional map of occupations showing the relationship of occupations to each other on the basis of the VPI. Occupations falling near each other are similar in the vocational interests of the students selecting them. Those falling far apart are quite different. The distance between the occupations in the configuration is a measure of their similarity or the degree to which they are related.

Forty selected occupations are mapped in Figure 1 along with the sample size for each group. It should be noted that occupational groups with similar titles are located close to each other. For example, note the two Art groups (4 and 5), Agricultural Science (2) and Farming (18), and the engineering groups--Chemical (8), Civil (10), Electrical (16), and Mechanical (25). The six VPI scales are superimposed on the map to relate the configuration to Holland's system.

In general, the occupational configuration presented in Figure 1 has face validity in that observers usually agree that jobs placed close together are similar in various ways while those far apart are quite different. In addition, the configuration conforms in a general way to groupings of

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[2]VPI means and standard deviations from Holland (1965, p. 32):

	R	I	S	C	E	A
Mean	4.3	5.4	4.5	3.2	4.6	3.6
SD	3.6	4.3	3.6	3.5	3.5	3.7

Figure 1. A Spatial Configuration of Occupations

This configuration is based on the Vocational Preference Inventory responses of male freshmen entering two-year (*) and four-year colleges who made the vocational choice listed. The size of the group selecting each occupation is given in parentheses.

1. Accounting (279)
2. Agricultural Science (166)
3. Architecture (83)
4. Art (45)
5. Art* (179)
6. Biology (55)
7. Business Management (360)
8. Chemical Engineering (94)
9. Chemistry (87)
10. Civil Engineering (185)
11. Clinical Psychology (42)
12. Construction* (103)
13. Counseling and Guidance (36)
14. Data Processing* (502)
15. Dentistry (120)
16. Electrical Engineering (259)
17. Elementary Education (117)
18. Farming (61)
19. Forestry (105)
20. History (57)
21. Journalism* (62)
22. Law (288)
23. Marketing (45)
24. Mathematics, Statistics (80)
25. Mechanical Engineering (152)
26. Medicine (354)
27. Music (41)
28. Natural Science Education (86)
29. Photography* (100)
30. Physical Education, Rec., Health (272)
31. Physics (61)
32. Political Science (76)
33. Public Relations, Advertising (40)
34. Radio, TV* (157)
35. Sales (64)
36. Speech and Drama* (40)
37. Teaching* (739)
38. Theology (77)
39. Undecided* (824)
40. Undecided (451)

occupations suggested by many theorists and empiricists such as Holland (1966a), Holland et al (1969), Roe (1958), Strong (1943), and Thorndike and Hagen (1962).

Relation to Holland's Classification

Holland (1966a,1969) has classified individuals and occupations according to codes based on the decreasing order of the VPI scale scores. There are two important ways in which the configural analysis differs from Holland's classification. First, Holland classifies on the basis of raw VPI scale scores while in the configural analysis standardized scores are used. Thus a scale with a mean score higher than other scales will appear more dominant in Holland's scheme than in ours.

While standardized scores could be used in the Holland system obviating the first difference, the second difference is due to a unique effect of the configural analysis. The location of a point on the plane is a simultaneous resolution of forces in the directions of the six scales. Holland selects the single largest force or ranks the forces to classify a profile.

The effect of these two differences in the two methods are illustrated by the occupation Mathematician. In Holland's scheme Mathematician is "IRCE" with Intellectual clearly dominant. When the scores are standardized, the ordering becomes ICRA and Intellectual and Conventional are nearly equally dominant. Now I and C are partially divergent interests, and the results of the configural analysis place the occupation between I and C (or near the R occupations) by resolving the forces of I and C. When occupations have divergent interest patterns, the two schemes will differ as they do on Mathematician. In the present data there were few cases of this kind of difference, however. When a profile is dominated by a single or reinforcing forces the two methods will yield similar results.

Use of the Configuration to Operationalize Some Concepts

Several concepts used by personality and vocational choice theorists can be operationalized by measurements in the planar configuration. Several examples follow.

Job similarity. The degree of similarity of interests of different occupational groups can be measured by the distance between those groups on the planar configuration. The closer two occupational groups, the more similar are the interest patterns of the groups.

Congruence of an individual and occupation. The congruence of an individual's interests with those of others selecting his occupational choice is a concept often discussed. In the planar configuration, this congruence can be measured by the distance between the individual's point on the plane and that of the occupational group. When an individual falls close to the occupation, we can say his interests are congruent with those of people in the occupation. When far away, we can speak of incongruence.

Stability of vocational choice. The stability of a vocational choice over time is an important concept often measured dichotomously. When a person stays with the same occupational choice, we say his choice was stable. A change to another occupational choice denotes instability. However, it seems that changing from one job choice to a very similar one does not represent the same degree of instability as changing to a vastly new and different area. Therefore, the distance on the plane between an original occupational choice and a later one would seem to be a reasonable measure of stability preferable to a simple categorical measure. On the plane a small distance would denote stability and a large distance, instability.

Differentiation of interests. Several authors have discussed a concept perhaps most clearly described as the degree of differentiation of interests.

By this we mean the degree to which a unitary interest (or reinforcing interests) dominates an interest profile. Interests in several divergent areas represents lack of differentiation as does approximately equal degrees of interest or disinterest in all areas. In the planar configuration this concept may be operationalized by measuring the distance of a profile point from the center of the plane. A profile with a dominant single interest or with a reinforcing interest pattern[3] would be far from the center. One with diverse intersts would be resolved to near the center of the plane.

Interest changes. One intriguing possibility is mapping an individual's changing interests over a period of time by following the resulting points from his profiles on the plane. For example, if an individual becomes increasingly mature in his vocational exploration and decision-making, his map may show successively decreasing between-job distances.

Research Applications of the Spatial Configuration

Several hypotheses can be tested within the framework of the configural analysis by using the operationalized concepts of the preceding section. We will state several research questions and present the answers that our type of analysis gives to the posed questions. It should be recalled that we are measuring interests only by the VPI and that the planar configuration ignores some of the dimensions of variability in the VPI. Thus our answers are limited by the framework in which they are posed.

1) Is the congruence of an individual's interests to those of others in his chosen occupation positively related to the stability of his vocational choice?

Most theorists would answer "yes" to this question. We correlated the

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[3]By a reinforcing interest pattern we mean strong interests in related areas (adjacent VPI scales) and/or great lack of interest in unrelated areas (areas falling on the opposite side of the plane).

congruence (the distance between an individual's planar point and that of the chosen occupation) with the stability of his vocational choice (the distance between his vocational choice as a freshman and his choice nine to twelve months later) for the 1943 students with all needed data. The correlation found was $r = .454$. This correlation is significantly different from zero at .001 level. Thus it seems that congruence is positively related to stability of vocational choice.

2) Is the person with more differentiated interests likely to be more stable in his vocational choices?

Many theorists postulate that differentiation is related to stability. However, we correlated differentiation as measured by distance from the center of the plane with stability for the same 1943 students and found a correlation of .043. This correlation is not even in the predicted direction. Thus it appears some reconsideration of the postulate or of our method of operationalizing the concepts is in order.

Several items favor the postulate. First the fact that Undecided groups of students fall quite near the center of the plane would lend initial support. An artifact of the planar configuration could also help account for the low correlation. Occupations located away from the center are farther apart in general. Thus any change may appear to be a large change for people with differentiated interests who likely select occupations away from the origin.

However, the planar configuration does raise the possibility that the postulated relationship is not of overriding importance. Consider, for example, occupations which fall near the center of the plane such as the teaching occupations. It would seem that people selecting the teaching occupations do have a variety of interests or undifferentiated interests, yet there seems little reason to expect instability of occupational choice.

Perhaps the stability of vocational choice for some people is determined by their finding an occupation suitable to their undifferentiated interests. Thus it seems that the planar configuration raises some interesting questions about the postulated relationship even though no clear answer is given.

Discussion of Potential Applications

There are many possible applications of the spatial configuration of occupations both in counseling and research. We have considered here two research questions and shown how the spatial configuration can be applied. Other research issues which can be explored include the way in which an individual's VPI profile point changes over time in relation to his occupational choice. Does he move closer to his occupational choice? The change in occupational choice over time in relation to an individual's point can be considered also. Does a person make consecutive choices which move closer to his interests? Further, the relationship of an individual's point to that of his occupational choice might be related to measures of his vocational maturity or job satisfaction.

If research shows consistencies in the use of individual and occupational points on the plane, then counselors can make use of the information both of occupational similarities and of an individual's location on the plane. For example, the visual occupational map could be used to show an individual where his interest profile falls and what occupational groups show similar interests.

While others have graphed occupations using various methods, this spatial configurations is unique in the way that it ties a visual picture of job similarities and individual interest profiles to a simple theoretical framework relating occupational interests to personality types. At the same time the occupational map accounts for a large portion of the variability

of VPI scores.

The simplicity of the two dimensional map is both its strength and weakness. The relationships of vocational interest patterns undoubtedly involve complexities unaccounted for in our configuration. At the same time, if the system proves meaningful its simplicity will be a great asset. The VPI data yields much important information in the two dimensional configuration. In many settings it is impossible to consider all of the complexities of occupational relationships. In those cases, this simple system which accounts for important occupational and individual differences may be most helpful.

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